Recommendations for Coordinating State, Federal, and Tribal Watershed and Salmon Monitoring Programs in the Pacific Northwest

Prepared by the
Pacific Northwest Aquatic Monitoring Partnership

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Contents

Executive Summary i

Background and Summary of Recommendations 3

Planning Module – Coordination Structure 12

Planning Module – Watershed Condition Monitoring 18

Planning Module – Effectiveness Monitoring 26

Planning Module – Fish Population Monitoring 31

Planning Module – Data Management Coordination 40

Appendix A –
List of Participants in the Pacific Northwest Aquatic Monitoring Partnership 46

Appendix B – Summary of Budget Information 47

Pacific Northwest Aquatic Monitoring Partnership
Coordinating State, Federal, and Tribal Watershed and Salmon Monitoring Programs in the Pacific Northwest

Executive Summary

The purpose of the Pacific Northwest Aquatic Monitoring Partnership (PNAMP or Partnership) is to coordinate important scientific information at the appropriate scales needed to inform public policy and resource management decisions.

Members of the Partnership have to date included state, federal, and tribal personnel with a common interest in coordinating various aspects of watershed condition monitoring, fish population monitoring, effectiveness monitoring, and management of resulting data.

Improved communication, shared resources and data, and compatible monitoring efforts provide increased scientific credibility and greater accountability to stakeholders.

Guiding principles of the Partnership relate to:

- Resource policy and management
- Efficiency and effectiveness
- Scientific basis
- Shared information

Much work has been accomplished over the last two years. This document describes those accomplishments and recommends the highest priority next steps to develop a regional plan to coordinate monitoring.

To succeed, the Partnership will require policy support and direction by member organizations, commitments of technical resources and staff time and ultimately, funding for the coordination itself.

In addition to a monitoring coordination structure, the Partnership has identified four key elements of monitoring, and within each has identified the highest priorities and related costs to improve coordination.

Recommendations and costs associated with a monitoring coordination structure, watershed condition monitoring, effectiveness monitoring, fish population monitoring, and data management are summarized in the following table.

Proposed Action Plan

	Key Element/Recommendation	Timeline	Cost *
Coordination Structure			
1.	Implement proposed PNAMP coordination structure to include: an Executive Network, a Steering Committee, Technical Groups, and a Coordinator jointly funded by PNAMP participants.	March 2004	$155K
2.	Agencies contribute in kind participation.	Continuous	($246K)
Watershed Condition – HABITAT			$15K/yr
1.	Develop a spatially balanced survey design and integrated sampling strategy that allows the aggregation of data at multiple landscape levels over the PNAMP area to which participants will tier their watershed condition surveys.	2004-06	
2.	Identify a core set of attributes and protocols that state, federal, and tribal monitoring programs will use for assessing status and trends in watershed condition.	2004-06	
3.	Identify and implement a process for developing/refining common GIS layers.	2004-06	
Effectiveness Monitoring – HABITAT & FISH			$15K/yr
1.	Develop a short list of high level indicators of salmon recovery and watershed health at a 3rd field level that can be aggregated to state and regional levels.	June 2004	
2.	Develop a regionally acceptable standard for obtaining statistically valid samples of habitat restoration projects to say with certainty that the projects sampled represent the effectiveness of the project category as a whole.	2005	
3.	Develop a list of habitat restoration project categories that if designed and constructed using documented BMP criteria are considered effective.		
4.	Identify attributes and protocols that state, federal, and tribal monitoring programs will use for assessing project effectiveness.	September 2004	
5.	Strategically place intensively monitored watersheds throughout the Pacific Northwest to monitor and evaluate cause and effect relationships between habitat changes and fish abundance.	2005	
Fish Population Monitoring – ABUNDANCE & HARVEST			$15K/yr
1.	Identify field sampling attributes and protocols that state, federal, and tribal monitoring programs will use for assessing status and trends in fish abundance, other biological indicators, and harvest.	August 2004	
Data Coordination			$15K/yr
1.	Complete detailed assessment of the data management coordination needs of PNAMP work groups and the PNAMP group as a whole	Begin February 2004	$30-55K
2.	Complete the PNAMP needs assessment including a gap analysis to determine what data management needs can be met by existing programs and what needs can be met with PNAMP coordination	Begin May 2004	Same as above
3.	Develop a PNAMP Data Management Coordination Plan including deliverables, timetable and budget.	Begin June 2004	tbd

* Initial estimates.

Background and Summary of Recommendations

Who is the Pacific Northwest Aquatic Monitoring Partnership?

An *ad hoc* group has been operating under the provisional title "Pacific Northwest Aquatic Monitoring Partnership," (referred to here as the Partnership, or PNAMP). Participation to date has included a wide range of organizations – state, federal, and tribal (Appendix A) with a common interest in coordinating watershed condition, fish population, and effectiveness monitoring efforts.

Why Was the Partnership Formed?

Federal Executives asked Aquatic and Riparian Effectiveness Monitoring Program (AREMP) staff to explore the possibility of developing a monitoring partnership with Washington, Oregon, and California agencies. This resulted in an *ad hoc* group of state and federal natural resource and watershed specialists meeting since November 2001 to discuss how to coordinate/integrate their different watershed condition monitoring efforts.

Over this same time period, several federal agencies were working together to develop a Columbia River Research, Monitoring, and Evaluation Program (RME) as required by ESA Columbia River Biological Opinions (BiOps) and a Columbia River Federal Salmon Recovery Strategy MOU (http://www.salmonrecovery.gov/strategy.shtml). More recently a draft RME Plan (http://www.efw.bpa.gov/cgi-bin/FW/welcome.cgi) was developed that calls for programmatic monitoring and expanded coordination with other federal and state monitoring programs. In recognition of the common objectives and various forms of overlap among the participants, the initial group decided to expand their state-federal monitoring partnership group to include the broader ESA RME planning and coordination effort, and to bolster the effort by inviting participation from tribal organizations.

The Partnership strives to recognize the unique responsibilities of its members, working together to facilitate advancement and progress on common objectives.

Why Monitoring and Evaluation is Important

Aquatic resources monitoring is a science-based approach that provides feedback to managers and to the public about how management plans and activities affect the aquatic environment. Monitoring also provides the basis for establishing program priorities, and for ensuring accountability for program expenditures.

Government agencies and other organizations use a variety of different monitoring efforts. Typically, these are independent efforts that address questions and management problems that are relatively unique to each agency. Such monitoring efforts have typically included little or no coordination with other agencies. However, new questions are now being asked that are best answered at large-scale landscape levels. This will necessitate coordination across traditional lines and creates a new set of challenges.

For example, the listings of various fish species across the Pacific Northwest under the Endangered Species Act has posed many new management questions and demands on the region's technical and institutional resources. A key challenge is how to evaluate resource management efforts at different scales in a way that is scientifically defensible and ecologically meaningful – how to link monitoring efforts at the watershed or subbasin scale with efforts at the larger scale of evolutionarily significant units.

The Partnership's Goals

Vision statement
Management decisions affecting Pacific Northwest watershed health and salmon populations are supported by coordinated state, federal, and tribal monitoring programs. Improved communication, shared resources and data, and compatible monitoring efforts provide increased scientific credibility and greater accountability to stakeholders.

Guiding Principles (assumptions)
Monitoring involves the deliberate and systematic observation, detection, and recording of conditions, resources, and environmental effects of management and other activities. There are many challenges associated with coordination of monitoring programs. The clear articulation by policy makers of guiding principles helps partners recognize program elements and objectives they share in common. The four principles outlined below are intended to provide a policy foundation for the framework for coordination presented in this plan. In addition, they can provide a basis to evaluate the extent to which the efforts of the Partnership are successful.

1. **Resource Policy and Management: The purpose of monitoring efforts is to coordinate important scientific information needed to inform public policy and resource management decisions.**

   Objectives:

   - Acknowledge each party's mandates, objectives, and management milestones.
   - Construct a monitoring program that meets each party's milestones and objectives through coordinating and sharing monitoring resources.
   - Develop a monitoring program that is sufficiently robust to meet public policy needs; demonstrate the links between public policy needs and monitoring efforts.
   - Develop a monitoring program that demonstrates compliance.
   - Commit to resolving scientifically the most important policy and management questions using an adaptive management approach.

2. **Efficiency and Effectiveness: Cooperative monitoring will enhance efficiencies and effectiveness of our respective and collective efforts.**

   Objectives:

   - Participate fully in the partnership, including the identification of contact(s) for monitoring issues.
   - Identify and coordinate goals, objectives, and budgets, and demonstrate resource savings over short and longer time frames.

- Cooperatively adapt programs and budgets to address monitoring gaps.
- State and federal agencies and the tribes commit to long term inter- and intra-agency monitoring programs.
- Encourage staff exchanges and shared training to learn what each other are doing (e.g., new innovations) and ensure consistency across programs.
- Develop common monitoring approaches, including quality control/quality assurance programs; shared evaluation tools; integrated status and trend monitoring efforts; land use, land cover, and riparian vegetation categorization; core data for representative subset of watersheds in all represented states.
- Perform all monitoring activities in a timely manner.

3. Scientifically Based: Environmental monitoring must be scientifically sound.

Objectives:

- Develop an integrated monitoring program e.g., issues, disciplines, and values.
- Monitoring program is based on shared goals and objectives e.g., census level, regional status and trends, cause and effect questions, effectiveness of regional efforts, identification of trouble spots.
- Address multiple spatial and temporal scales.
- Develop and use compatible data collection and analysis protocols.
- Recognize inherent diversity and variability and dynamic inter-relationships or resource conditions in monitoring design, analysis and interpretation.
- All environmental data must have a known level of precision.
- All baseline data on ecosystems are known and compiled between agencies.

4. Shared Information: Monitoring data must be accessible to all on a timely basis.

Objectives:

- Make strategic investments in information systems needed to make data useful.
- Monitoring databases would integrate a number of issues, disciplines and values.
- Data management systems and protocols provide a linkage for sharing data between agencies.
- Develop and use common data sharing protocols.
- Develop and use common database of core metadata, data, and electronically connected distribution systems.

Accomplishments of the Partnership to Date

Relationship Building

- Strengthened relationships between state and federal agencies involved with monitoring watershed conditions in the Pacific Northwest.
- Identified major areas to improve integration of monitoring programs.
- A groundswell of interest has expanded our coordination efforts to include other agencies and tribes interested in monitoring aquatic systems.

Products to date (all are still in draft form) are available upon request:

- Planning Document (this paper)
  - Vision statement.
  - Guiding principles.
  - Overview of state-federal monitoring partnership.
  - Workgroup planning documents.
  - Options and implications for aquatic monitoring coordination.
- **Protocol Table**: compares habitat attribute protocols used for watershed condition monitoring/surveys.
- **Specialist Table**: compares implementation, effectiveness, and validation monitoring and also sample designs among watershed condition monitoring/surveys.
- **Executive Table**: provides a general overview of the intent and coverage of major monitoring/surveys.

Next Steps: Developing a Regional Plan to Coordinate Monitoring

What is needed?

To succeed, the Partnership will require policy support and direction by member organizations; commitments of technical resources and staff time; and, ultimately funding for the coordination itself. An *ad hoc* approach as manifested by the Partnership reflects a good first step. It has helped to establish the need for coordination, has brought people and perspectives together to wrestle with new questions and issues, and has helped define the opportunities that improved coordination can bring to the region. The Partnership now needs additional support to encourage and sustain the myriad of coordination challenges. Although the commitment of these resources is not without cost, significant savings can be achieved through increased effectiveness at the project scale to improved efficiencies at the program scale.

Recommendations to Achieve Improved Coordination

Increased coordination is needed to achieve the vision of the Partnership. Executive policy guidance is also needed to guide advancement toward the desired level of improved coordination. At present the Partnership is operating without such policy guidance. Consequently, the Partnership has developed this plan as a way to facilitate identification by executives of the resource needs of the Partnership and to facilitate discussion between, and decision-making by, the many sponsors of the Partnership.

To assist decision-makers in determining an appropriate level of support, we have identified four levels of coordination that may be desired. The characteristics of the four different levels, identified as minimal, basic, medium, and high, are described in Table 1. The table is further organized using three monitoring elements identified by the Partnership as priorities for improved coordination – **watershed condition monitoring, effectiveness monitoring, and fish population monitoring**. Together, these elements inter-relate to help meet public policy needs, explain trends or the effects of actions, and clarify implications for management.

Elements for improved coordination:

Watershed Condition Monitoring – integrated status and trend monitoring will detect both current status and the trend in status of watershed attributes over time. It helps explain trends relative to land uses, and helps explain relationships to effectiveness/validation, and correlates with fish population status and trend monitoring. It uses compatible probabilistic

Table 1. Characteristics and Implications of Different Levels of Monitoring Coordination (Editor: Kelly Moore (OWEB)).

Coordination Level	Watershed Condition Monitoring	Effectiveness Monitoring	Fish Population Monitoring
Minimal – Status Quo	Independent watershed assessment and monitoring programs. No effort to integrate probabilistic sampling designs that allow making inferences at the landscape scale. Some common protocols and indicators. No shared analysis or application to landscape scale management or policy. Data sharing restricted to sending yearly reports to other agencies.	Evaluation of individual projects and management actions. Independent, potentially redundant, efforts to document program or policy effectiveness. Independent small-watershed studies. Inability to evaluate cumulative effects of restoration projects at the landscape scale.	Fish population monitoring at many different spatial scales: stream reaches, index watersheds, sub-basins, and ESU's. No coordinated reporting or analysis.
Basic – Information Sharing, Improved Compatibility, Less Redundancy	Continue current "informal" coordination efforts: monitoring program representation from NW Forest Plan; Federal Caucus, States, CRITFIC, BPA, others. Activities include: • Identify active and developing monitoring programs in PNW-CA • Describe common monitoring attributes and associated protocols. • Work to improve coordination and sharing of data • Improve communication with coastal, Puget Sound, and Columbia Basin tribal monitoring programs • Identify common attributes of WA, OR, CA, and FHPS Bi-Op monitoring strategies.	Comprehensive **Implementation Monitoring** for Restoration Projects, Management Actions and Recovery Programs. • Independent tracking of restoration actions conducted by various entities. **But,** make commitment to create compatible data structures. • Establish timeframe and protocols for sharing information.	Optimize current and planned fish monitoring activities. • Develop templates for a regional hierarchical structure that may organize fish monitoring at population and spatial scales. • Coordinate reporting of fish research and monitoring activities.

Coordination Level	Watershed Condition Monitoring	Effectiveness Monitoring	Fish Population Monitoring
Medium – Agreement to coordinate complimentary implementation of monitoring activities and monitoring program development	Expand **Basic** level of coordination to all watershed condition monitoring within the Pacific Northwest: state, federal, and tribal organizations. Create ability to share data across all landscapes. Explore potential for interagency and intergovernmental agreements that commit to following: • Utilize probabilistic sampling designs adapted to individual program needs • Standardize protocols for core attributes, or develop "cross-walks" that combine data collected using different protocols. • Develop and use common GIS layers, e.g., stream hydrography, roads, watershed boundaries, harvest and fire history, vegetation. • Develop systems for sharing data in a timely manner	Develop Coordinated-Regional Strategy for **Project Effectiveness Monitoring** • Shared Protocols • Development and Application of Experimental Designs • Evaluation of project classes depending on different program and agency focus.	Expand current status and trend monitoring to Columbia Basin ESU's • Utilize probabilistic sampling designs adapted to individual program needs Develop network of watershed level population monitoring – start with existing programs • Sponsor biennial conference to share research and monitoring results • Link fish monitoring to project effectiveness monitoring.
High –	Expand **Medium** level of coordination for watershed condition monitoring to incorporate "nested" project effectiveness monitoring and long-term watershed-scale studies. • Use project level monitoring to help evaluate watershed condition • Work towards overall monitoring implementation plan that accommodates common information needs • Establish process for monitoring results to be shared and used at policy levels throughout the region.	**Watershed Scale Effectiveness Monitoring** Interagency and interjurisdictional cooperation to establish a network of "Intensively Monitored Watersheds" that systematically evaluate restoration actions, management programs, and other influences on watershed health and salmon populations. Protocols Reporting etc.	Develop explicit working relationships between state programs, Columbia Basin Fish and Wildlife Authority (CBFWA), NW PPC, BPA, and Federal "Action" agencies

sampling designs, field sampling protocols, data management protocols, and analytical tools to address multiple spatial and temporal scales of interest.

Effectiveness Monitoring – coordinated monitoring that will explore the effectiveness of management actions, projects, or classes of actions at geographic scales of interest. It relies on an experimental design approach utilizing treatments and controls. It addresses key management questions, and helps explain relationships to status and trend and validation monitoring components.

Fish Population Monitoring – coordinated monitoring to determine both the current status and the trend in status of fish population attributes over time. It is needed for various effectiveness/validation monitoring experiments, and examinations of relationships to results from watershed condition status and trend monitoring.

Tools and Methods

A key focus for the Partnership has been to identify a shared perspective of monitoring tools and methods that, when used in common, allow current and new information to be viewed and used by decision-makers at various (different) scales across the landscape. This often means being able to "roll-up" local information to larger scales, or may involve relating information from larger scales across different jurisdictional boundaries. It involves both "what" is monitored, and "how" the information is collected in the field and made available through information systems.

Initial Recommendations to Coordinate Monitoring for the Five Key Elements

The members of the Partnership have developed recommendations that, if implemented would improve coordination of monitoring for five key elements:

- a coordination structure for the Partnership,
- watershed condition monitoring,
- fish population monitoring,
- effectiveness monitoring, and
- assessment of data management requirements necessary to support a regional monitoring program.

Recommendations from workgroups addressing these five elements is outlined in this document in five planning modules. Information in each module includes: overviews of ongoing coordination efforts, accomplishments to date, and what needs to be done by the Partnership (including expected tasks, products, timelines, and estimated costs).

The results of this work are intended to support:

- A regional monitoring coordination and implementation plan for the Pacific Northwest to support salmon recovery and watershed enhancement programs in the states of California, Oregon, Washington, and Idaho.
- Responding to the June 2003 letter containing recommendations from the governors of Washington, Oregon, Idaho, and Montana calling for a draft coordinated monitoring system for the Columbia River Basin.
    - This document provides recommendations for institutional commitments and funding options for the Governors to consider.

- Mandates for coordination between state, federal, and tribal agencies stipulated in the Federal Salmon Recovery Strategy (the "All H paper") for the Columbia River Basin.
- Agency requests for funding and staff time to implement coordination efforts of the Partnership.

Summary of Recommendations

The table below provides an abbreviated overview of initial recommendations of the Partnership, including rough timeframes and projected costs.

Key Element/Recommendation	Timeline	Cost *
Coordination Structure		
Implement proposed PNAMP coordination structure that would include: an Executive Network, a Steering Committee, Technical Groups, and a Coordinator jointly funded by PNAMP participants.	March 2004	$155K
Agencies contribute in kind participation.	Continuous	($246K)
Watershed Condition – HABITAT		$15K/yr
Develop a spatially balanced survey design and integrated sampling strategy that allows the aggregation of data at multiple landscape levels over the PNAMP area to which participants will tier their watershed condition surveys.	2004-06	
Identify a core set of attributes and protocols that state, federal, and tribal monitoring programs will use for assessing status and trends in watershed condition.	2004-06	
Identify and implement a process for developing/refining common GIS layers.	2004-06	
Effectiveness Monitoring – HABITAT & FISH		$15K/yr
Develop a short list of high level indicators of salmon recovery and watershed health at a 3rd field level that can be aggregated to state and regional levels.	June 2004	
Develop a regionally acceptable standard for obtaining statistically valid samples of habitat restoration projects to say with certainty that the projects sampled represent the effectiveness of the project category as a whole.	2005	
Develop a list of habitat restoration project categories that if designed and constructed using documented BMP criteria are considered effective.		
Identify attributes and protocols that state, federal, and tribal monitoring programs will use for assessing project effectiveness.	September 2004	
Strategically place intensively monitored watersheds throughout the Pacific Northwest to monitor and evaluate cause and effect relationships between habitat changes and fish abundance.	2005	

Fish Population Monitoring – ABUNDANCE & HARVEST		$15K/yr
Identify field sampling attributes and protocols that state, federal, and tribal monitoring programs will use for assessing status and trends in fish abundance, other biological indicators, and harvest.	August 2004	
Data Coordination		$15K/yr
Complete detailed assessment of the data management coordination needs of PNAMP work groups and the PNAMP group as a whole	Begin February 2004	$30-55K
Complete the PNAMP needs assessment including a gap analysis to determine what data management needs can be met by existing programs and what needs can be met with PNAMP coordination	Begin May 2004	Same as above
Develop a PNAMP Data Management Coordination Plan including deliverables, timetable and budget.	Begin June 2004	tbd

Coordination Structure Planning Module

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Introduction

Monitoring efforts have appropriately evolved in response to different organizational mandates, jurisdictional needs, issues and questions. Given inherent differences however, much overlap exists across broad geographical areas, and there are issues and questions that are shared in common.

Managers often implement actions to improve the status of fish populations and their habitats in streams and rivers. Until recently, there was little incentive to monitor such actions to see if they met their desired effects. Now, however, many programs require that funded actions include monitoring efforts. Within the Pacific Northwest, several different organizations, including federal, state, tribal, local, and private entities currently implement management actions and conduct monitoring studies. Because of diverse goals and objectives, entities are using different monitoring approaches and protocols. In some cases, different entities are measuring the same (or similar) things in the same streams with little coordination or awareness of each other's efforts.

Several large-scale, comprehensive monitoring programs have operated in the Pacific Northwest in the recent past, each of which has faced considerable coordination challenges within its respective jurisdiction or area of influence. Examples of such large-scale, comprehensive monitoring efforts include:

- Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan (AREMP),
- Pacfish/Infish Biological Opinion for the interior Columbia Basin (PIBO),
- Interior Columbia Basin Ecosystem Management Program (ICBEMP),
- Federal agencies developing a Columbia River Research, Monitoring, and Evaluation (RME) Program as required by ESA Columbia River Biological Opinions (BiOps) and a Columbia River Federal Salmon Recovery Strategy MOU, and
- Comprehensive, monitoring efforts within the states of OR, WA, CA, ID.

Many other ongoing monitoring programs exist or are planned to operate at smaller scales, or to address a narrower array of management issues. A few examples of these include:

- Collective and individual tribal monitoring programs,
- Individual agency (e.g., federal, state, local) monitoring programs, and
- Co-manager harvest and hatchery monitoring.

In addition, in June 2003, the governors of Oregon, Washington, Idaho, and Montana jointly asked the Northwest Power and Conservation Council to design an integrated, complementary and scientifically sound monitoring system for the Columbia River by the fall of 2003. [1]

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) represents an emergent effort to enhance technical and policy coordination across existing monitoring programs. The intent of PNAMP is to coordinate and guide monitoring strategies or plans in order to reduce redundancy, increase efficiency, and help meet the goals and objectives of the various entities involved in monitoring. Further, PNAMP is intended to provide an effective coordination mechanism for refinement of aquatic monitoring and support programs, and for coordinated analysis and reporting of results.

Accomplishments to Date

To date, PNAMP has operated in an *ad hoc* capacity. Participation has included a wide range of organizations – state, federal, and more recently, tribal. PNAMP strives to recognize the unique responsibilities of its members, working together to facilitate advancement and progress on common objectives. Substantial executive level support has been provided for the continuation of PNAMP with a request for a draft coordination plan by the end of 2003.

Since its inception, PNAMP activities (technical efforts and linkages to policy forums) have been facilitated by the AREMP team leader. The AREMP team leader has also provided meeting space and edited group work products. **AREMP will be unable to provide these services beginning in 2004.**

PNAMP has proposed options to achieve different levels of desired coordination. PNAMP has also reviewed existing monitoring structures to identify those that may correspond to desired coordination options. PNAMP concluded that a coordination structure does not now exist that would fulfill the "vision" of PNAMP.

Where Do We Need To Go?

At this juncture, obtaining enhanced coordination through PNAMP will require the following:

- an organizational structure that provides policy support and direction by member organizations,
- commitments of technical resources and staff time, and
- funding for the desired level of coordination.

To address these needs it is recommended that a new structure be created via mutual agreement to fulfill the vision and principles of PNAMP. The structure should achieve the level of coordination desired.

Principle components of a desirable structure include: an **Executive Network, a Steering Committee, Technical Groups, and a PNAMP Coordinator**. Each component is outlined below.

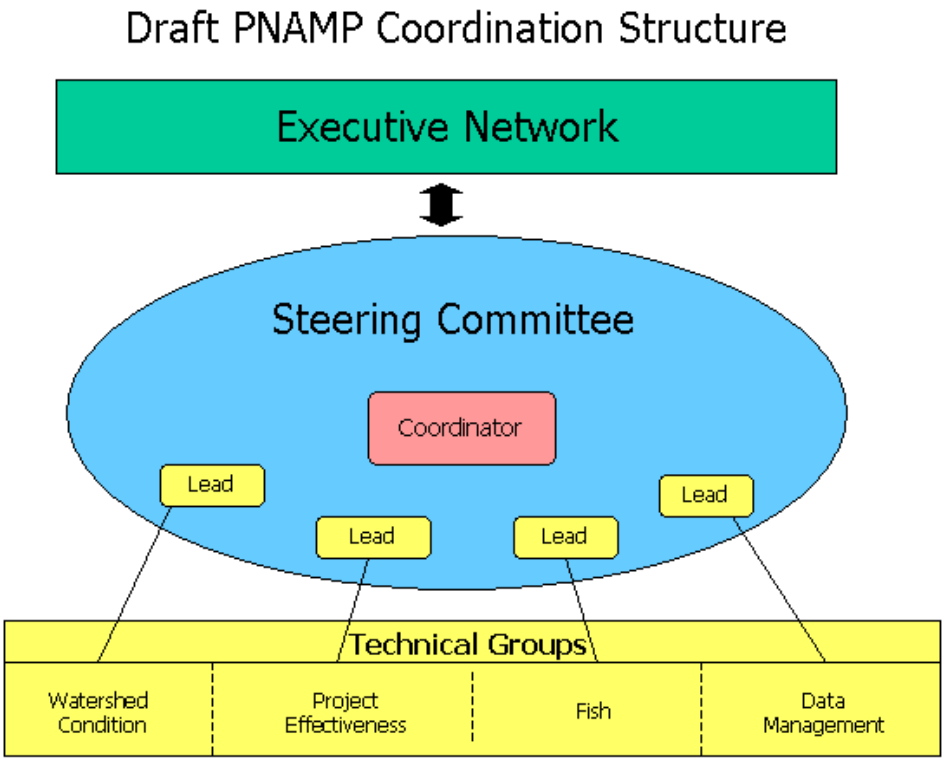
[1] "Recommendations for Protecting and Restoring Columbia River Fish and Wildlife and Preserving the Benefits of the Columbia River Power System" June 2003.

- The Executive Network is comprised of pre-existing groups of policy executives with interests in monitoring that are represented by PNAMP member organizations. This network would provide policy direction and support to PNAMP as needed. Examples of executive groups include:Federal agency executives
    - Intergovernmental Advisory Committee of the Northwest Forest Plan
    - Northwest Power and Conservation Council
    - State monitoring-oriented executives in Oregon, Washington, California, Idaho (e.g., statewide monitoring councils)
    - Tribal executives

- The **Steering Committee** would be comprised of technically knowledgeable policy staff, and policy knowledgeable science staff. The purpose of this committee is to provide an interface between science and policy that would effectively bridge monitoring science, policy, planning, and implementation interests faced by PNAMP members. It would:
    - provide the key linkage to the Executive Network for purposes of communication, and recommendations as needed for policy consideration,
    - develop a committee charter that would ensure that common monitoring coordination policy, technical, and adaptive management objectives are met,
    - help ensure appropriate staff are assigned to technical workgroups,
    - provide clear reporting requirements, structures, standards, and schedules,
    - in coordination with the Executive Network, seek financial security for the PNAMP – seek commitments of agency funding to address key gaps, and
    - be staffed/facilitated by the PNAMP Coordinator.

- The **PNAMP Coordinator** would:
    - operate in a neutral manner, and have no vested interest in the outcomes of monitoring activities,
    - be employed by an appropriate administering organization or agency (e.g., governmental (US Geological Survey), quasi-governmental (Pacific States Marine Fisheries Commission), non-governmental (For the Sake of the Salmon), or academic organization (Oregon State University Natural Resource Institute)),
    - facilitate the efforts of and report to the Steering Committee,
    - serve as the lead staff, liaison, and point of contact for PNAMP,
    - facilitate communication and coordination of products across technical workgroups, as appropriate,
    - provide fiscal/contract coordination and management support for PNAMP,
    - administer PNAMP activities (e.g., prepare agendas and notes, convene meetings, edit group products), and
    - facilitate development, implementation, and tracking of PNAMP work plans.

- **Technical Groups** would, as needed and at the direction of the Steering Committee and PNAMP Coordinator:
    - provide technical expertise to address PNAMP issues and products,
    - coordinate technical aspects of watershed condition, effectiveness, and fish population monitoring, and related data management issues,
    - coordinate with each other and the PNAMP Coordinator and report to the Steering Committee, and
    - synthesize results of PNAMP.



Resources Needed

Resources and estimated costs will vary depending on the level of coordination and the pace of coordination desired (*see options matrix in Table 2, wherein structure options are aligned with options for desired levels of coordination).*

Resource needs over the next several years outlined below are those for the "basic," "medium," and "high" coordination options in Table 1. Note: these are the estimates for overall coordination, which should be viewed along with coordination needs of technical workgroup modules. Some efficiencies should be expected. See PNAMP budget spreadsheet (Appendix B).

- **Staffing** (beginning January 1, 2004):
    - Coordinator – 1 FTE
    - Part-time facilitator – .2 FTE
    - Staff (administrative, technical writer) – .5 FTE

- Policy participation – in-kind
- Technical participation – in-kind

- **Budget**:
  - Coordinator, overhead, and support staff – $150,000/yr
  - Part-time facilitator – $4,800/yr (at PNAMP general meetings)
  - Policy participation (in-kind) – Basic $0; Medium $0;
    - High $20,000: includes funding to attend meetings (salary and travel).
  - Technical participation – Basic $0; Medium $60,000; High $100,000+
    - Medium and High: provides funding support for those traveling long distances (i.e., need to buy a plane ticket) to attend meetings, and some salary costs.
  - Estimated total annual cost:
    - Basic option: $100,000
    - Medium option: $215,000
    - High option: $300,000

- **Other forms of support needed:**
  - Meeting rooms
  - Report preparation and dissemination
  - Web site development and maintenance
  - Conference and symposium support

Table 2. Structure Options to Achieve Different Levels of Desired Coordination

Coordination Level (from Table 1)	**Features of Structure Option**	**Comment/New Cost**
Minimal – status quo	Status Quo – • Executive Network – loosely identified • Informal workgroup only; No recognized policy or technical groups • Coordinator time and member participation are volunteered	High risk that PNAMP activity would not be sustainable. New Cost: None
Basic – Information sharing, improved compatibility, less redundancy	Informal – emphasis on communication • Executive Network – informal but explicitly identified • Coordinator position is funded to facilitate activities of the Partnership • Relies on informal technical workgroups • Loosely organized policy and science staff • Participant staff time is volunteered	With paid Coordinator, this option improves likelihood that some progress could be made on PNAMP priorities; however, progress is dependent upon the level of participation volunteered by members. New Cost: low; est. $100k
Medium – Agreement to coordinate complimentary implementation of monitoring activities and monitoring program development	Enhanced informal – beyond communication, emphasis includes more coordination of design and analysis • Executive Network – informal but explicitly identified • Chartered Steering Committee provides science-policy interface and linkage to Executive Network • Dedicated Coordinator position that facilitates and staffs Steering Committee • Recognized technical workgroups • Some commitment (compensation, dedicated in-kind) of participants	Should allow substantial progress on key priorities in the next few years New Cost: medium; est. $200k
High – Integrated	Semi-formal – multi-layered structure would be accountable for expanded coordination and actual integration of monitoring programs • More formal Executive Network and commitments • Chartered Steering Committee provides science-policy interface and linkage to Executive Network; rotating Chair • Dedicated Coordinator position that facilitates and staffs Steering Committee • Formal technical workgroups • Compensation for participants	Most formal option, that if successfully implemented, could provide a high level of coordination. This level of formality is not needed to make substantial progress in the next few years, but could be utilized in the future, as warranted. New Cost: $300k

Watershed Condition Monitoring Planning Module

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This chapter provides an overview of the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) watershed aquatic monitoring coordination efforts, along with a proposal and timeline for further products and coordination efforts to

- identify common monitoring questions, and as appropriate
- standardize sampling designs,
- standardize sampling protocols, and
- ensure that existing and new data can be shared among all interested parties.

Monitoring discussed in this chapter is focused on physical and biological condition of the watershed. Monitoring for fish condition and action effectiveness research is covered in subsequent chapters.

Overview of Coordination Efforts

Survey Design

Why is it of interest?

Using a common probabilistic sample design will allow us to provide annual data summaries and annual report cards on the condition (based on key indicators) of riverine/riparian/watershed resources and track changes and trends over time at broad regional scales (e.g., statewide; ecoregion wide; federal lands; Interior Columbia).

A variety of watershed monitoring efforts are either ongoing or proposed. Three basic site selection sampling designs for status and trend monitoring are in use and share common features, but are designed to meet different objectives. A fourth, the Action Agencies/NOAA Fisheries RM&E Plan for tributary status monitoring in the 2000 FCRPS Biological Opinion, is proposed and will be implemented through three pilot subbasins in 2004. Our goal is to clarify how these efforts might be coordinated so we can appropriately use each other's data to make inferences at a variety of landscape scales.

- AREMP (Westside federal interagency monitoring program) - randomly select 6th field subwatersheds (hereafter referred to as "watersheds") throughout the Northwest Forest Plan (NWFP) area. Within each selected watershed, randomly select (on 1:100,000 stream layer) and sample 4-12 sites to characterize the watershed.
    - Used for federal interagency effort to answer question: what is the status and trend of watershed condition in the NWFP area?
    - In-channel attributes (collected at stream reach scale), and riparian and upslope characteristics (derived from GIS layers) are aggregated together in a decision support model (DSM) to describe watershed conditions.

- Spatially balanced environmental status and trend monitoring (EMAP) programs in Idaho, Oregon and Washington – randomly selected sample sites across the landscape (on 1:100,000 stream layer).
    - Used by states to answer question: what is the status and trend in key parameters related to biological condition, habitat condition, and water quality? This approach is also used by some states to determine status and trend in salmon population abundance.
    - Information collected at the stream reach scale is used to characterize conditions at the watershed, region, and ESU population scale.
- PIBO (Eastside federal monitoring program) - randomly select 6th field watersheds throughout the PacFish/InFish area. Within each selected watershed, physical habitat, aquatic biota, and riparian vegetation attributes are sampled within the lowest response reach (the "integrator reach") on public land.
    - Used by the USFS and BLM to answer the question: Is the management direction from PacFish and InFish resulting in improved conditions of stream and riparian areas?
    - Baseline conditions are being assessed by comparing managed versus reference watersheds and trends described using a repeated measures design.
- Status monitoring for the Action Agencies/NOAA Fisheries BiOp RM&E Plan –random sampling design.
    - Will be used to monitor environmental performance requirements for listed salmon and steelhead populations.
    - This environmental status monitoring will be performed in combination with fish population monitoring and action effectiveness research monitoring.
    - Pilot projects are planned in 2003 for the John Day, Wenatchee, and Upper Salmon subbasins to further test and coordinate sampling designs and protocols.
    - As part of the Wenatchee project, a draft Upper Columbia Basin Monitoring Plan is in review that identifies proposed monitoring indicators, sample design, and monitoring protocols.

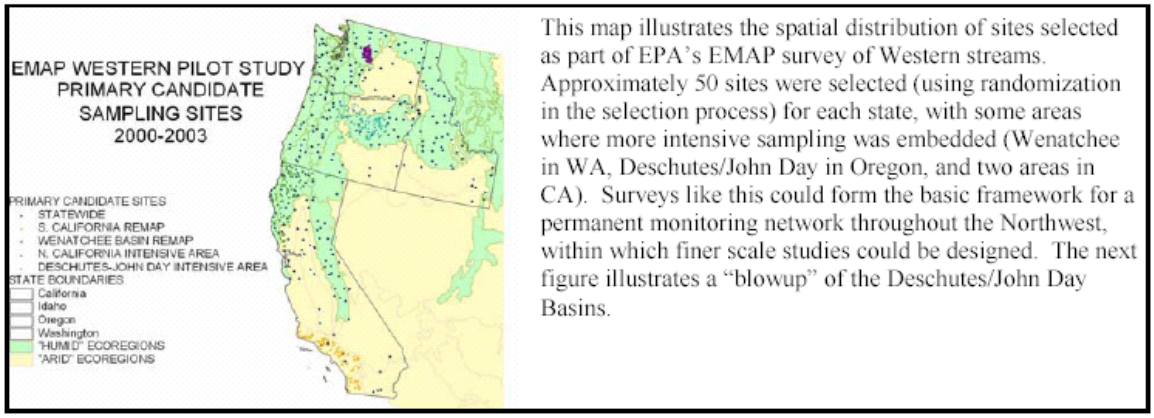
Accomplishments to date

There is general agreement among PNAMP participants for using the generalized random tessellation stratified survey (GRTS) procedure developed by EPA to ensure a random, spatially balanced placement of sampling sites. EMAP uses GRTS to establish its sampling points. The AREMP and PIBO programs are currently using GRTS to randomly select watersheds for sampling. AREMP then again uses GRTS to select the sample sites within the chosen watersheds. PIBO arbitrarily samples the lowest response reach, which means it's not appropriate to combine their reach-scale data with EMAP or AREMP reach scale data (P.Larsen, personal communication). Monitoring programs in the states of Oregon and Washington utilize similar approaches that need to be reconciled with federal approaches.

Recent efforts have shown how to combine state (ODFW) and federal (AREMP) data that are based on a probabilistic sampling design. (P.Larsen, S.Lanigan, K.Jones, T.Kincaid and T.Olson. 2003. Evaluating the Condition of Riverine-Riparian Resources in the Pacific Northwest. Western Division of American Fisheries Society presentation.).

Coordination tasks

- Coordinate state and federal watershed status and trend monitoring efforts into an integrated sampling strategy. This may lead to changes in locations or watersheds selected for sampling for both state and federal monitoring program sample sites, but would allow for improved efficiencies for use of data across a variety of scales.
- Develop a sampling proposal (based on using GRTS) that will allow the aggregation of data at multiple landscape levels, while simultaneously meeting the needs of individual PNAMP agencies. Corvallis EPA Laboratory personnel have offered to assist with the design, once agreement is reached regarding the concept and the particulars of its implementation.
    - Sample Framework. Establishing broad level (e.g., region wide, statewide) sampling of 50 – 100 locations annually over a period of five years, with some locations monitored annually and others once during the five year period; then repeat the cycle for the next five years, and so on. This would yield a total of 250 – 500 locations on which to make "five-year" reports (assume annual reports as well).
    - Flexibility. The sampling design can be modified over time as we learn more about important "subpopulations" on which to focus monitoring.
    - Scalability. Design framework would be set up to accommodate finer scale monitoring embedded in the broader scale design to promote data sharing (effectively increasing sample sizes and addressing reach-scale effectiveness questions.



Note: The text in this figure refers to an enlargement in a subsequent figure, but there is no subsequent figure in this document.

- Timeline 2003-2004:
    - In coordination with other PNAMP workgroups, convene a workgroup to flesh out the general concept conveyed in this document, identify the pieces of the puzzle, and figure out how to solve each piece and assemble into the whole.
        - What are the specific target sampling populations to be characterized (e.g., all perennial stream networks? All watersheds (e.g., all 6th field watersheds)?
        - Do we want to embed some surveys at the outset?
        - How do we create institutional collaboration (and financial support)?
        - Logistics (who conducts the surveys? Who manages the logistics? Quality control?). Who manages the data?

    - The habitat group, like the other workgroups, will develop in concert with the information management work group a mechanism to generate and maintain information management system to service the diverse needs of the partnership. This will include the defining data needs, data dictionaries and performance targets for the information management system.
    - Information management.
- Timeline 2005-2008:
    - Continue to meet and resolve questions/conflicts that arise from implementing a "global sample design."

Adoption of Common Field attributes and Protocols

Why it's of interest

If everyone agrees to use an integrated survey design, the next step is to consider what attributes and protocols are being used. Use of different attributes and sampling protocols currently makes it impossible for data to be combined to achieve the improvements in efficiency and economy of scale that is anticipated from a State, Federal and tribal status and trend monitoring partnership.

We must first agree on the "attributes" being used. For example, even though we might agree that "fines" are an important attribute to evaluate, one group means fines in pool-tail riffles; another means reach-wide fines (within wetted width), and yet another means reach-wide fines (within active channel width). Secondly, groups need to agree to use a specific protocol (e.g., a random sample of surface particles in 4 tail-out riffles using Wolman pebble count). The use of incompatible protocols will prevent either the pooling of data or comparisons between programs.

Accomplishments to date

- Common in-channel and biological core attributes and protocols were implemented by AREMP and PIBO field crews in the 2003 field season.
    - This effort was in response to states' request to have federal monitoring programs better integrated, and to provide input to BPA effort for developing standardized protocols that will be used to monitor restoration projects.
- A census was assembled of the diverse protocols that are used by the participating federal and state agencies that currently monitor watershed condition.
    - This effort was a requisite step in identifying the degree of difference between programs and the specific opportunities that existed for cooperation between programs via reasonable alterations of protocols. This work also identified those areas where research is required to evaluate the relative performance and potential compatibility of different indicators.
- The ESA federal RME Plan has identified status and action effectiveness performance measures (environmental/population level attributes) with proposed protocols. Pilot projects are planned for field implementation in 2004 for the John Day, Wenatchee, and Upper Salmon subbasins to further test common or consistent protocols, coordinated within their respective states.
- States of Oregon and Washington have identified core attributes and protocols.
- Washington Salmon Recovery Funding Board and Interagency Committee for Outdoor Recreation have put together a list of attributes (and protocols) to be used for local scale effectiveness monitoring; the attributes are tailored to the particular "treatment" type.

Coordination tasks

- Identify a core set of indicators and their associated attributes and protocols that state, federal, and tribal monitoring programs will use for assessing status and trends in watershed condition.
  - Develop a process for determining what protocols to use (e.g., cost, precision and variance, trend detection capability, repeatability, has "statistical blessing")
  - In parallel with developing a unified set of protocols, we will also develop calibrations for older protocols (aka a "crosswalk") in order to preserve the value of legacy data where possible.
- Timeline: 2003-2004
  - Recommend which in-channel (physical, biological, chemical) attributes and robust protocols should be used.
    - Workshops and meetings:
      - October 2003: National Park Service North Coast and Cascades Network long-term monitoring workshop: water temperature and stream physical characteristics.
      - November and December Wenatchee and John Day pilot project workgroup sessions.
      - Nov 2003: Indicators of Watershed Condition (at 3rd field HUC). Oregon Plan for Salmon and Watersheds.
      - Dec 2003: Workgroup to compare data collected by various protocols.
      - Dec 2003: Workshop to develop landslide evaluation protocols.
      - Jan 2004: AREMP-PIBO coordination meeting.
      - Feb 2004: Protocols recommended for use/testing in 2004 field season.
      - Feb 29 - March 4, 2004 Annual Meeting of the Western Division of the American Fisheries Society - Salt Lake City, Utah.
      - Nov 2004: Large scale watershed monitoring symposium at the North Pacific International Chapter - American Fisheries Society (Skamania Lodge, WA).
    - Field season tests:
      - Upper Columbia Basin protocol comparisons.
        - Develop cross walk tables if protocols are different and it's logistically impossible to change protocols.
      - PIBO comparison of field data collected by centralized crew versus individual forest crews.
  - Timeline: 2005-2008:
    - Develop remote sensing tools to map roads and characterize in-channel physical attributes.
    - Identify and implement the needed components of a QA/QC program (training, repeat visits, data management).
    - Recommend upslope and riparian process monitoring techniques (surrogates for wood and sediment delivery, and changes in hydrograph)
      - Road density and proximity to stream
      - Landslides
      - Vegetation type and seral state

Data sharing, management, data analysis, interpretation and reporting

Why it's of interest

- Each agency is currently restricted to collecting and reporting data collected on lands or attributes associated with its areas of authority or responsibility. This creates boundary issues that hamper looking at larger landscape scales, which in turn makes it virtually impossible to determine changes in overall watershed condition.
- Common data sets and analysis tools will enable agencies and other partners to answer the same questions. Assuming we have an integrated sampling design, it will also allow agencies to share and analyze data at different scales with more precision.

Accomplishments to date

- The current version of the interagency hydrologic unit code (HUC) layer mapped to the 6th level HUC covering WA, OR, and northern CA is now available for use for both analysis/mapping and maintenance at http://hydro.reo.gov/hu.html. This dataset is now in a maintenance phase and Framework Partners are working collaboratively to improve the data quality.
- The PNW Hydrography Framework Clearinghouse is in the implementation phase. The Clearinghouse provides a repository for spatial and core attribute information for watercourses, waterbodies, and water points information within Oregon and Washington. Loading of data for priority subbasins is now in progress. Information on the Clearinghouse and downloadable data may be found at the following location: http://hydro.reo.gov.
- Associated with the Clearinghouse is the Hydro Stewards web site. This ArcIMS site displays hydro steward contact information for each 5th Level (Watershed) in the PNW. By clicking on a watershed the contact information can be displayed. Watershed councils and other interested parties may also be displayed. This may have utility for scientists interested in accessing local knowledge. http://ims.reo.gov/website/hydrostewards
- Streams hydrography
  - The PNW Hydrography Framework partnership is developing the 1:24,000 stream layer for Oregon and Washington. This dataset is comprised of "best available information" from the framework partner organizations (USFS, BLM, Oregon and Washington). The initial data load should be completed by the end of calendar year 2004. Work will continue to improve accuracy and consistent stream densities. The 1:24,000 stream layer is about done in WA.
  - A 1:24,000 hydrography layer has been developed by CA Dept. of Forestry and the Institute for Forest and Watershed Management at Humboldt State University.
- Vegetation (interpreted from Landsat images).
  - The Interagency Vegetation Mapping Project (IVMP) is now complete for all lands within the Northwest Forest Plan area in Washington and Oregon (Note: the Klamath and Willamette Valley provinces are completed and in review) The California Vegetation Mapping Program (CALVEG, 2000) is complete for the Northwest Forest Plan area in California.
    - Seral state, and vegetation composition, i.e., hardwood, conifer, mixed, are mapped at 25 m pixels.
    - Stand replacing changes resulting from harvest or fire can be tracked, starting from 1996.

- Roads layer
  - A landscape wide transportation dataset (BLM's GTRN layer) is now complete and in a maintenance phase for the full extent of the NWFP in Oregon and Washington. BLM created this dataset from multiple federal and state sources. BLM has focused on the federal lands component of this dataset and, therefore, the road densities are greater in those areas.
- A roads layer covering all federal, state, and private lands is not available. No coordinated effort is currently underway to develop this layer. IRICC and the NWFP Regional Ecosystem Office committed to cooperative development of a transportation dataset encompassing Washington, Oregon, and northern California. The IRICC Transportation team has developed and agreed on a core set of attributes and protocols. These standards provide a linkage to various existing datasets, and will facilitate the development of an interagency dataset. The IRICC website provides a listing of known transportation information projects in the PNW http://www.reo.gov/iricc/Integration%20Strategy.htm and transportation framework project information can be found on the following location http://www.reo.gov/gis/projects/Roads/index.htm.
- Initial phase of Washington's data portal is online (www.swim.wa.gov).

The ESA federal RME agencies have been participating in an ongoing regional data needs assessment project that is part of the Northwest Power Planning Council's Fish and Wildlife Program. A regional data management plan is required by September 2003 under the ESA federal RME efforts. A pilot project data management system is being implemented in 2003 as part of the status and action effectiveness pilot projects in the John Day, Wenatchee, and Upper Salmon.

Coordination tasks

- Timeline 2003-2004:
  - Identify process for developing/refining common GIS layers
    - Consistently densified 1:24,000 stream layer
    - Fish distribution on 1:24,000 stream layer
      - StreamNet has been the organization responsible for regional scale fish distribution data in the Pacific Northwest. StreamNet data are currently only at the 100K scale, they are anticipating going to the 24K scale when the regional 24K hydrography is finished and available. Once the hydrography is available, it will take a little time working with the field agencies to complete the fish distribution at that scale. Streamnet already has relationships and procedures set up with the fish and wildlife agencies to do this work. And, their Washington people are already working at this scale, so some data may be available at that scale sooner.
      - The Hydro Clearinghouse (http://hydro.reo.gov) has just transitioned the Clearinghouse from the REO and is now deploying it in the an operational environment where the BLM, USFS, and the states of Oregon and Washington will co-manage the dataset. They are just beginning to load data at this time and this will be an extended process since they are integrating partner's data prior to loading. As a partnership, they are also embarking on a redesign effort for both the data and the data access infrastructure. Their hope is that the Clearinghouse will eventually provide one set of geometry at 24k for all uses here in the PNW.

    - Fish barriers (natural and human-caused, e.g., culverts) on 1:24,000 stream layer
    - Vegetation (satellite imagery)
    - 1:24,000 roads layer with core set of attributes.
    - 6th-field watershed boundaries.
    - Harvest history
    - Fire history
    - Landslides
- Timeline 2005-2008
    - Implement process for developing/refining GIS layers described above.
    - Hold workshops to show how to aggregate data using a decision support model.
    - Describe how data across jurisdictions and geographic areas will be rolled up and reported to the public, Congress, Governors, Legislators, and federal, state, and tribal executives and leaders.

Resources Needed

Budget

- See PNAMP budget spreadsheet (Appendix B).

Effectiveness Monitoring Planning Module

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Overview of Coordination Efforts

Effectiveness monitoring (research) measures environmental parameters to ascertain whether management actions implemented were effective in creating a desired outcome at either the project (stream reach) or watershed scale. It relies on an experimental design approach utilizing treatments and controls. It is anticipated that monitoring for effectiveness research may often overlap and inform status monitoring of habitat or fish condition.

Determining the effect of management actions must be linked to monitoring focused on answering questions at appropriate spatial and temporal scales. For example, whether or not planted trees produce shading for the stream is the first level of a cause and effect hypothesis. The entire hypothesis may be stated more completely: If I plant trees near the stream, then they will grow and produce shade. The shade will help lower water temperature and stabilize the shoreline, thus improving fish habitat and leading to more fish. Project-scale effectiveness monitoring for such a riparian improvement would evaluate local habitat outcomes, which are directly affected by the project and are expected to be measurable. Mechanistic relationships between projects and fish abundance are often harder to demonstrate. At the watershed scale, on the other hand, ecological processes occurring upstream or upslope from the project, as well as out-of-watershed effects, increasingly influence higher-level outcomes such as the viability of salmonid populations. This reality challenges our ability to determine cause-and-effect effectiveness at larger spatial scales.

Among the PNAMP workgroup, there is general agreement that a regional network of Intensively Monitored Watersheds (IMW) is needed to evaluate restoration projects, programs, and policies at the landscape scale. Effectiveness monitoring at the scale of the IMW is focused on the general question: Does the collective effect of restoration actions result in improved watershed condition? Evaluating watershed condition relies on status and trend monitoring of specific ecosystem components, including water quality, stream morphology, riparian function, and the viability of wildlife populations, including salmon. The IMWs are designed to assess the relative contribution of restoration actions within the context of other factors or ecological stressors that may degrade systems. Intensive watershed-scale monitoring, for example, might be a case study that examines the net impacts of total maximum daily loading (TMDL) requirements for various water users on the overall water quality of the basin.

Why is it of interest?
The U.S Congress, the Northwest Power and Conservation Council, and State Legislatures allocate hundreds of millions of dollars each year to aid recovery of federally listed West Coast salmonids and enhancement of other non-listed anadromous and resident fish. One example is the Bonneville Power Administration's Fish and Wildlife Program, which has contributed to this task for many years. Other federal Agencies participate through the Northwest Forest Plan and Interior Columbia Basin Biological Opinion, the Pacific Coastal Salmon Recovery Fund and the Columbia Basin Salmon Recovery Strategy. Oregon, Washington, and California each support local restoration funding initiatives and utilize allocated federal funds. In addition, independent tribal governments throughout the region support their own fisheries management and restoration programs and participate in the federally funded programs. Indeed, these various agencies have over the last five years funded over 11,000 individual actions across the Columbia River Basin alone.[2]

There is a tremendous need to document the contribution that these efforts are making to improvements in watershed condition and listed species. Established processes provide appropriate fiscal accountability. Strategic and coordinated action effectiveness research is critically needed to assess the impact of all of these investments.

Agencies have implemented various effectiveness monitoring projects at different scales using different protocols and timeframes based on the needs of disparate management initiatives. Agencies have approached monitoring using their own resources, needs, and procedures. As a result, there is limited capacity to roll up results from ongoing monitoring into larger scale assessments of success. In addition, there is no commonly agreement on what indicators of success should be used. Under the status quo of current monitoring efforts, there is a profound lack of usable verifiable data or reports that document cause and effect relationships between money spent upon habitat recovery and fish populations.[3]

The ability to communicate effectively the results of habitat restoration and protection projects, and other salmon recovery activities, is a continual challenge. Those individuals working closely with habitat and fish issues speak in technical terms and metrics not well understood by others. On the other hand, "decision-makers" at the highest levels of government, in the U.S. Congress and State Legislature, want to know the answers to basic accountability questions about the money they have appropriated to solve the salmon crisis. They seek answers to questions like:

- Have our efforts done any good?
- How many new fish have been produced?
- How much more money is needed?
- How much longer until we achieve success?

[2] Reporting agencies include: Washington Salmon Recovery Funding Board, Oregon Watershed Enhancement Board, Bureau of Land Management, US Forrest Service, Pacific Coast Salmon Recovery Fund, NOAA Restoration Center, Oregon Water Trust, Washington Water Trust, Bonneville Power Administration, Columbia River Inter-Tribal Fish Commission. Estimated number of projects as of November 20, 2003: 11,651 (NOAA-Fisheries restoration project database).

[3] Independent Science Panel (ISP). 2002. Response of salmon and trout to habitat changes. ISP Technical Memorandum 2002-2. Olympia, WA. http://www.governor.wa.gov/gsro/science/documents.htm

These basic questions cannot be answered, unless a significant amount of existing and new information is obtained and rolled up in a manner that, to date has typically not been done. There is a growing realization and real risk of losing significant funding for salmon and habitat recovery if the region does not demonstrate that coordinated monitoring on a broad scale is occurring that will answer the questions posed by those who appropriate money.

Accomplishments to Date

U.S. Forest Service/Bureau of Land Management: effectiveness of management plans.
The Aquatic/Riparian Effectiveness Monitoring Program (AREMP) is determining if the Northwest Forest Plan Aquatic Conservation Strategy is restoring and maintaining aquatic and riparian ecosystems to desired conditions on federal lands in the Plan area ("west of the Cascades")?

The PIBO monitoring effort is determining if key biological and physical attributes, processes, and functions of upslope, riparian, and aquatic systems are being degraded, maintained, or restored within the geographic range of PACFISH and INFISH? ("east of the Cascades").

Both programs rely on a probabilistic survey design to provide status/trend information. The assumption is that improving status of watersheds is proof that the associated management plans are effective in restoring national forest watersheds.

Columbia River Federal Caucus

The Research, Monitoring, and Evaluation Plan for the Federal Columbia River Power System BiOp and the Salmon Recovery Strategy calls for monitoring status/trends, effectiveness at the project scale, and effectiveness at the watershed scale.

Funding was provided by the Bonneville Power Administration (BPA) to implement pilot studies in the Wenatchee, John Day, and Salmon River watersheds. The Columbia Basin Fish and Wildlife Authority (CBFWA) was also provided funding through BPA to conduct a collaborative system-wide monitoring and evaluation assessment to inventory existing status/trend monitoring of salmon stocks, assess the strength and weaknesses of existing monitoring, and design improved monitoring methods. Another project with ESSA technologies is currently assessing the ability of existing data to answer questions on the effectiveness of habitat actions and recommending methods for improving future assessments.

The BPA is working to create greater accountability when issuing project contracts for monitoring and reporting effectiveness through the NPCC Fish and Wildlife Program. Coordination under PNAMP will help guide further modification of projects toward a more regionally coordinated and efficient programmatic framework of status and action effectiveness research.

Washington Salmon Recovery Funding Board (SRFB)

The SRFB has recently funded intensive monitoring in selected watersheds in Puget Sound and the Lower Columbia River in order to demonstrate the cause and effect relationships between habitat projects and fish abundance in those watersheds. The SRFB is also in the process of addressing project scale effectiveness monitoring in a scientifically rigorous manner.

Oregon Watershed Enhancement Board (OWEB)
OWEB functions as the agency responsible for coordinating monitoring efforts conducted in support of the Oregon Plan for Salmon and Watersheds. In this role, OWEB provides leadership and support for monitoring activities conducted by the Department of Fish and Wildlife, Department of Environmental Quality, Department of Forestry, and Department of Agriculture. OWEB also provides grant funds for watershed assessments and monitoring projects carried out by watershed-based organizations. These projects typically focus on evaluation of the effectiveness of specific restoration actions. OWEB's monitoring strategy supports the concept of intensively monitored watersheds as the key element needed to link project monitoring to effectiveness monitoring at the watershed scale. Watershed effectiveness monitoring, in turn, will be linked to Oregon's approach to sub-basin scale status and trend monitoring of salmon populations and watershed conditions.

Pacific Coastal Salmon Recovery Fund (PCSRF)
NOAA Fisheries administers the PCSRF allocations to the states and tribes. Congress has asked for greater accountability of these funds. NOAA Fisheries has just implemented extensive monitoring requirements with the PCSRF participants to track specific outcomes of monitoring. The outcomes are mostly statistics about miles of stream affected by various project actions. Effectiveness of these actions is the next component to be built.

Where Do We Need To Go?

Seven dials

The region should develop a short list of high level indicators (seven dials) of salmon recovery and watershed health that can be aggregated to state and regional levels that provide a simplified explanation of progress that Governors, Legislators, and the public can understand.

Randomized sampling protocols

A regionally acceptable standard for obtaining statistically valid samples of projects is needed in order to say with certainty that the projects sampled represent the effectiveness of the category of project as a whole.

Best Management Practices

Develop a list of habitat restoration project categories that if designed and constructed using documented Best Management Practices criteria are considered effective.

Uniform streamside sampling protocols

To the extent possible a uniform list of indicators and protocols for sampling habitat and fish should be developed that have demonstrated that they have the lowest variance, highest signal to noise ratios, and are the most cost effective to measure. This work can build upon the comparisons already developed through the PNAMP.[4]

[4] DRAFT Habitat attributes used for watershed condition monitoring/surveys (in wadeable streams) Based on agency input and website info (8/14/03)

Strategically placed Intensively Monitored Watersheds

The Wenatchee, John Day, Abernathy-Mill Creek, Big Beef-Seabeck watersheds are the first watersheds to begin tying cause and effect relationships within a watershed for salmon recovery. Other IMWs need to be identified and funded to prove effectiveness of habitat restoration actions upon salmon populations.

Ongoing coordination

The PNAMP includes a broad spectrum of agencies and tribes that have interests and responsibilities for watershed health and species recovery. Many of the members of the PNAMP also participate in other regional monitoring efforts. Notably, the Columbia Basin Fish and Wildlife Authority (CBFWA) has initiated the CBFWA System-Wide Monitoring and Evaluation Project (CSMEP) that includes participants whose responsibilities overlap with PNAMP but also includes a even broader range of fish and wildlife management agencies.

Resources Needed

Staffing

PNAMP members, with the support of their respective agencies, need to work through the process of identifying standardized protocols and procedures. Agreement on field protocols and sampling procedures will support a regional capacity to strategically allocate monitoring resources.

Budget

- See PNAMP budget spreadsheet (Appendix B).

Fish Population Monitoring Module

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Overview of Coordination Efforts

Historically resource management agencies and other entities have used a variety of independently developed fish population monitoring efforts to address questions and management problems that are often unique to each agency. In recent decades listing of many fish populations in the Pacific Northwest under the Endangered Species Act (ESA) further taxed the monitoring capabilities and institutional resources of individual resource management agencies. Those agencies are now challenged to develop and coordinate larger scale monitoring efforts such as the one that has evolved in the Columbia Basin that crosses traditional jurisdictional boundaries. At the same time they must develop ways of linking existing and still important traditional small scale monitoring efforts to address larger scale issues. The needs for larger scale monitoring and linking of traditional smaller scale monitoring efforts have given added impetus to greater coordination among participating agencies,

The ad hoc group of state, tribal, and federal organizations now operating under the provisional title "Pacific Northwest Aquatic Monitoring Partnership" (PNAMP) has evolved in response to that impetus.

PNAMP has prioritized four major elements of monitoring for improved coordination: watershed condition monitoring, effectiveness monitoring, fish population monitoring, and database management. This module describes basic coordination issues with respect to fish population monitoring, the status of coordination efforts to date for each of these issues, and a roadmap for what must be completed in the future.

Finally, overall communication, data and resource sharing, standardization and coordination for both large and small scale monitoring and evaluation programs is presently absent or inadequate between and among all major efforts and parties. **The Fish Population Monitoring (FPM) Committee** and PNAMP process intends to address these deficiencies in a direct and collaborative manner with the outcome aimed at increasing cost effectiveness, clearer delineation of performance standards, enhancing comparability between and among M&E efforts and providing greater integration of programs and essential fish population information.

Implementation

In order to setup a fish population monitoring program, it is important to follow a logical sequence of steps. By proceeding through each step, the investigator will better understand the goals of monitoring and its strengths and limitations. These steps should aid the investigator in implementing a valid monitoring program that reduces duplication of sampling efforts, and thus overall costs, but still meets the needs of the different entities. The plan assumes that all entities involved with implementing the plan will cooperate and freely share information.

Setup steps:

1. Identify the populations and/or subpopulations of interest (e.g., spring
2. Chinook, steelhead, bull trout).
3. Identify the geographic boundaries (areas) of the populations or subpopulations of interest.
4. Describe the purpose for selecting these populations or subpopulations (what are the concerns?).
5. Identify the objectives for monitoring.
6. Select the appropriate monitoring approach (status/trend or effectiveness monitoring or both) for addressing the objectives.
7. Identify and review existing monitoring and research programs in the area of interest.
8. Determine if those programs satisfy the objectives of the proposed program.
9. If data gaps exist, implement the appropriate monitoring approach by following the criteria outlined below.
10. Classify the landscape and streams in the area of interest.
11. Describe how data collection efforts will be shared among the different entities.
12. Identify a common database for storing biological and physical/environmental data.
13. Estimate costs of implementing the program.
14. Identify cost-sharing opportunities.

Common Characteristics of Fish Population Monitoring Programs

Once the objectives for the program have been identified, as described above, the **Fish Population Monitoring Committee** will focus on the following themes to provide guidance and facilitate coordination and standardization to managers in the Northwest and West Coast.

Problem statement and overarching issues:

- Identify and describe the problem to be addressed.
- Identify boundaries of the study area.
- Describe the goal or purpose of the study.
- List hypotheses to be tested.

Statistical design:

- Describe the statistical design to be used (e.g., EMAP design).
- List and describe potential threats to external validity and how these threats will be addressed.
- If this is a pilot test, explain why it is needed.
- Describe descriptive and inferential statistics to be used and how precision of statistical estimates will be calculated.

Sampling design:

- Describe the statistical population(s) to be sampled.
- Define and describe sampling units.
- Identify the number of sampling units that make up the sampling frame.
- Describe how sampling units will be selected (e.g., random, stratified, systematic, etc.).

- Describe variability or estimated variability of the statistical population(s).
- Define Type I and II errors to be used in statistical tests (the plan recommends no less than 0.80 power).

Measurements:
- Identify indicator variables to be measured.
- Describe methods and instruments to be used to measure indicators.
- Describe precision of measuring instruments.
- Describe possible effects of measuring instruments on sampling units (e.g., core sampling for sediment may affect local sediment conditions). If such effects are expected, describe how the study will deal with this.
- Describe steps to be taken to minimize systematic errors.
- Describe QA/QC plan, if any.
- Describe sampling frequency for field measurements.

Results:
- Explain how the results of this study will yield information relevant to management decisions.

Scale

Scale has biological, spatial and temporal attributes. Biological scale ranges from a large multi-species assemblage to the sub-population level within a species. Spatial scale is typically defined by standard descriptive geographic boundaries such as basin, sub-basin, watershed, tributary, etc. Temporal scale can range from intra-annual fish life cycle events to multi-generational trends in fish populations associated with decadal or longer climate cycles.

Scale directly impacts all other aspects of a monitoring program. While the scale is initially dependent upon the defined monitoring objectives, political, fiscal, and logistical considerations often play crucial roles. Scale may require very extensive coordination at either end of the spectrum. On one hand, monitoring on a very large scale requires extensive collaboration and coordination during implementation and often fails because of lack of commitment among participating resource management agencies. On the other hand small-scale studies may be used to make inferences or comparisons at larger scales. Attempts to extrapolate results of small scale studies to large scales that cross regulatory boundaries may ultimately meet with failure because participating agencies are unable or unwilling to commit to the consistent experimental designs, methods, or data standards that are required.

Numerous efforts have been underway in the Pacific Northwest to coordinate the monitoring of salmon and trout. Following are many of the major monitoring and coordination efforts that the FPM Committee with incorporate into their guidance and standardization agenda.

Adult and Juvenile Harvest and Abundance Estimates

Pacific Salmon Commission (PSC)

The states of Alaska, Washington, and Oregon coordinate and share salmon population monitoring information with treaty Indian tribes, the Canadian government, and NOAA Fisheries on a continuing basis to develop overall ocean adult abundance estimates, harvest estimates, and marine survival estimates for all indicator stocks of chinook, coho, pink, chum, and sockeye

salmon within the treaty area (Oregon, Washington, British Columbia, and Alaska). The PSC relies heavily upon the participating agencies for data and on the North America Pacific coast-wide coded wire tagging program. Consult the PSC website for details at http://www.psc.org/Index.htm

Pacific Fishery Management Council (PFMC)
The Magnuson Stevens Act provides for fishery management councils to manage fisheries within the EEZ of the coastal United States and its territories. The PFMC sets harvest seasons and tracks harvest for the EEZ along the Pacific coast of California, Oregon, and Washington. Abundance estimates are developed by the various state, federal, and tribal experts and reported to the PFMC. The PFMC also uses information provided by the PSC on Canadian and Alaskan harvest to help determine coastal EEZ harvest. Consult the PFMC website for member organizations and other details. At http://www.pcouncil.org/

Columbia River Compact
Cooperative sharing of harvest and abundance data for the Columbia River. Includes Oregon, Washington, Idaho, tribes, US. Fish and Wildlife Service and NOAA Fisheries. The Compact operates within the constraints of US v Oregon and the Biological Opinion for the Columbia River Federal Power System. Abundance estimates are based upon abundance at the mouth of the Columbia River after taking into consideration harvest regulated by the PSC and the PFMC Harvest estimates and abundance estimates are agreed upon by the technical team and presented to the Compact for considerations.

Columbia River Fish Passage Center
The Fish Passage Center (FPC) provides current and historic data on salmon and steelhead passage in the mainstem Snake and Columbia River basins. Data from the Smolt Monitoring Program (SMP) are intended to provide the information basis for federal, state and tribal recommendations for fish passage in the Federal Columbia River Hydro-electric System. In addition to real-time access to SMP data, the FPC provides data about river conditions, hatchery releases, smolt migration, and adult returns as well as spawning ground survey data.

Smolt monitoring and transport has been a major concern of the states, tribes, and federal action agencies involved with hydroelectric facilities. Monitoring the abundance of juvenile migrants is of prime importance in determining overall freshwater production and productivity and in determining the strength of returning adult spawning migrations and overall health of the population or ESU.

Smolt monitoring began initially at dam sites where juvenile migrants were impinged against screens, plunged over spillways, and passed through turbines. Biologists began to devise methods of trapping smolts to develop estimates of abundance and future harvest in Alaska and elsewhere in the late 1940s and early 1950s. Most of the initial efforts entailed using fyke nets placed below weirs or intake structures. Later efforts developed into the current system of using floating inclined plane traps and screw traps to safely sample migrants in rivers of all sizes as long as there is sufficient current to allow the trap to fish. Trap locations are not randomly selected and are not necessarily indicative of the population or ESU where they are currently employed, but are more a result of available funding, local interest, and harvest prediction needs.

Currently there are a sprinkling of juvenile migrant traps located throughout Washington, Oregon and northern California. There are estimates available for total watershed migrant production for selected species where traps can be calibrated with recaptures of known releases of marked migrants. Elsewhere, only raw trap counts are available that provides a relative index of abundance from year to year but no true abundance estimates. There currently is little or no cooperation among agencies where juvenile migrant traps are placed, but are mostly based on the need of the funding agency. The one notable exception is juvenile migrant trapping at main-stem dams in the Columbia-Snake system where migrants are tracked as they pass through each hydroelectric facility.

Individual agency actions

Individual estimates of spawner escapements and juvenile production are the purview of the individual states, tribes, having jurisdiction. Once obtained, these estimates feed the deliberations and modeling conducted by the Columbia River Compact, PFMC, and PSC. Methods for sampling spawners and/or redds vary within the organization and within organizations depending upon local needs or desires. Recent Oregon Department of Fish and Wildlife coastal coho spawner abundance has relied upon EMAP random sampling of spawning areas, whereas other areas rely upon redd count flights or dam counts. There has been limited coordination at the field sampling level in developing coordinated statistically valid adult abundance sampling.

Biological Indicators and Protocols

This section provides an example of "core" set of biological and physical/environmental indicator variables that will be measured within all watersheds and streams that receive status/trend and effectiveness monitoring (Tables 3 and 4). The purpose of the Fish Monitoring Module and Committee is to review, develop, implement and coordinate these standard and protocols throughout the Northwest and West Coast to enhance consistency and comparability.

This example "core" variables represents the minimum, required variables that will be measured. Investigators may elect to measure additional variables depending on their objectives and past activities. For example, reclamation of mining-impact areas may require the monitoring of pollutants, toxicants, or metals. Some management actions may require the measurement of thalweg profile, placement of artificial instream structures, or livestock presence. Adding these indicators will supplement the core list.

Indicator variables identified in this plan are consistent with those identified in the Action Agencies/NOAA Fisheries RME Plan and with most of the indicators identified in the WSRFB (2003) monitoring strategy. The Action Agencies/NOAA Fisheries selected indicators based on their review of the literature (e.g., Bjornn and Reiser 1991; Spence et al. 1996; Gregory and Bisson 1997; Bauer and Ralph 1999) and several regional monitoring programs (e.g., PIBO, AREMP, EMAP, WSRFB, the Oregon Plan). They selected variables that met various purposes including assessment of fish production and survival, identifying limiting factors, assessing effects of various land uses, and evaluating habitat actions. Their criteria for selecting variables were based on the following characteristics:

- Indicators should be sensitive to land-use activities or stresses.
- They should be consistent with other regional monitoring programs.
- They should lend themselves to reliable measurement.
- Physical/environmental indicators would relate quantitatively with fish production.

Table 3. Draft example list of Biological indicator variables.

General characteristics	Specific indicators
Adults	Escapement/Number
	Age structure
	Size
	Sex ratio
	Origin (hatchery or wild)
	Genetics
	Fecundity
Redds	Number
	Distribution
Parr/Juveniles	Abundance
	Distribution
	Size
Smolts	Number
	Size
	Genetics
Macroinvertebrates	Transport
	Composition

Table 4. Draft examples of recommended protocols and sampling frequency for biological indicator variables (from the Upper Columbia Monitoring Strategy).

General characteristics	Specific indicators	Recommended protocol	Sampling frequency
Adults	Escapement/Number	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual
	Age structure	Borgerson (1992)	Annual
	Size	Anderson and Neumann (1996)	Annual
	Sex ratio	Strange (1996)	Annual
	Origin (hatchery or wild)	Borgerson (1992)	Annual
	Genetics	WDFW Genetics Lab	Annual
	Fecundity	Cailliet et al. (1986)	Annual
Redds	Number	Mosey and Murphy (2002)	Annual
	Distribution	Mosey and Murphy (2002)	Annual
Parr/Juveniles	Abundance/Distribution	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual
	Size	Anderson and Neumann (1996)	Annual
Smolts	Number	Murdoch et al. (2000)	Annual
	Size	Anderson and Neumann (1996)	Annual

	Genetics	WDFW Genetics Lab	Annual
Macroinvertebrates	Transport	Wipfli and Gregovich (2002)	Annual/Monthly
	Composition	Peck et al. (2001)	Annual

Accomplishments to Date

There is general agreement that, at any biological scale below species, all fish population monitoring programs should be designed to measure or estimate four basic attributes:

1. genetic structure and diversity,
2. production (numbers of individuals) at various life stages,
3. productivity (usually a reproductive or survival rate measurement such as returns per spawner, smolt to adult survival, etc) and,
4. habitat quantity and quality.

A well coordinated monitoring plan must insure that:

1. managers are in agreement about the attributes to be measured to address the monitoring objectives,
2. managers insure that estimates or measurements are adequate to address disparate goals,
3. measures or estimates are made at levels of accuracy and precision adequate to answer management questions and,
4. estimates or measures are consistent among programs in a collaborative effort.

To address these concerns, a number of actions are under way:

- The Columbia Basin Fish and Wildlife Authority (CBFWA) is currently assessing all of the ongoing fish related monitoring in the Columbia Basin on behalf of the Northwest Power and Conservation Council.

- The Upper Columbia and John Day Pilot Studies will be testing tessellated random sampling of adult spawners against census methods to determine their comparative value.

- A series of Intensively Monitored Watersheds (IMWs) will be tracking juvenile migrant production against basin habitat changes to verify production cause and effect relationships.

- Recent collaborative efforts of Johnson et al. (in prep) with respect to resolving protocol and standardization of methods used to count fish. A draft report of these efforts is expected in June 04.

The previous examples also relate to the second issue of disparate research goals. Traditionally we recognize three purposes for measuring or estimating the four basic attributes of a fish population:

1) to assess the status of the population,
2) to identify genetic, temporal, or spatial trends in the population, or
3) to experimentally determine causative factors for observed trends.

Given policy level impetus, multi-agency progress with respect to sample design and methods consistency can occur with surprising alacrity. For example – monitoring programs designed to implement the Pacific Salmon Treaty. In that arena there is now significant coordination and standardization with respect to coast wide marking programs, analysis of mark recovery data,

escapement estimation procedures, sample sizes, accepted levels of accuracy and precision, analysis of genetic data (e.g., standardization of loci) etc.

Where Do We Need To Go?

While progress is being made, there are still large collaborative gaps. For example, while Johnson et. al. the John Day and Upper Columbia are making great strides towards standardization of direct counting methods, there is a great need to standardize indirect estimation procedures such as mark recapture programs, analysis of coded wire tag data etc. Despite major strides in the area of fish genetics there is still woefully poor coordination with respect to methods and analytical standards. Some progress has occurred recently among Pacific Salmon Treaty signatories with respect to genetic stock id protocols and standards but similar collaboration is lacking in other areas.

Work under this project will assemble, organize by fish species and sampling method, scientifically review, and publish a directory of recommended protocols for counting the 125+ species of salmonids, resident fish, and lampreys in the Pacific Northwest. The primary objectives tied to the protocols herein reflect (1) establishing baseline presence/absence and distribution data, (2) estimating population size, (3) monitoring population trends, and (4) strengthening fish-habitat relationships. The primary audience for products from this effort is managers, researchers, educators, and others concerned with fish and lamprey population management, recovery planning, and habitat actions. The products from this project will be available in hardcopy (for field use) and digital formats (e.g., CD/Internet) and will enhance the overall utility, and strengthen the conservation efforts of users.

Staff from Washington Department. of Fish and Wildlife, Tetra Tech FW, Columbia River Intertribal Fish Commission, the Wild Salmon Center, Northwest Habitat Institute, Oregon Department of Fish and Wildlife, British Columbia Ministry of Environment, The Colville Tribes, Canadian Department of Fisheries and Oceans, Alaska Department of Fish and Game, Columbia Basin Fish and Wildlife Authority, NOAA Fisheries, and other organizations, will assemble a wide array of protocols. These protocols and data collection guidelines are from Washington, Oregon, British Columbia, Idaho, Montana, Wyoming, Utah, Nevada, Alaska, California, and elsewhere. Each protocol will be reviewed, and an outline of features such as the intent, methods, applications, training requirements, data flow, blank and example data forms, source, and related elements will be recorded. A workshop will be held from 9-12 March 2004, during which biometricians, experienced field workers, and database managers will assist in reviewing and prioritizing the draft list of recommended protocols.

Together with introductory chapters on monitoring fish populations and how to use the directory, there will be a section linking the protocols to an array of specific *sampling methods* (e.g., angling, counts, electro fishing, hydroacoustics, mark-recapture estimation, nets, seines, spawner surveys, snorkeling, traps, video). By cross-referencing the protocols to their respective species and sampling methods, the intent is to provide a framework so that users have clearer guidance on which protocols should be used for the projects and monitoring efforts they are intending to undertake.

Scale and intensity of monitoring efforts differ significantly with respect to their purposes. Whereas data collected to assess population trends may also be adequate to assess status, the

converse is likely not to be true. Similarly, data collected to address causative factors may not be suitable to assess either status or trends.

Sample design and sampling protocols consistency are perhaps the thorniest yet potentially the most tractable coordination issues that we must address.

Timeline

The Fish Population Monitoring Committee will host a series of workshops aimed at providing guidance on protocols, tools and coordination beginning in February of 2004. Each of the workshops will result in a draft set of recommendations for the larger PNAMP steering committee to review. Work on the FMP protocols etc. will continue through November of 2004. In November of 2004 a conference symposium will be held in conjunction with the North Pacific Chapter of the American Fisheries Society (November 1-3 in Stevenson WA.). A section on "Large Scale Monitoring" will be used to convene all PNAMP modules for discussion, presentation. A wrap-up session at this conference will allow PNAMP to chart its course for 2005 and beyond. Following the workshop and subsequent formal peer review, a subset of protocols will be recommended for consistent use across the Pacific Northwest. The main products being delivered are the publication (web access and hardcopies) which will contain a synthesis of each protocol, tables linking the arrays of project types to corresponding protocol(s), and web access (i.e., hot-link) to the full and downloadable text and data forms for the recommended protocols themselves.

Depending upon funding, proceedings from this conference will be published.

Resources Needed

1. Workshop facilitator
2. FPM team lead
3. GIS support
4. Meeting rooms
5. Travel fund
6. Publication support
7. Other direct costs for printing, communication, etc.

Budget

- See PNAMP budget spreadsheet (Appendix B).

Data Management Coordination Planning Module

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Introduction

Adequate access to information related to salmon recovery and watershed health is a critical unmet need. For example, the U.S. Congress Conference Report (108-10) regarding appropriations for federal fiscal year 2003 stated:

> *"The conferees note the lack of accountability and performance standards for resources distributed to restore endangered and threatened salmon through the Pacific Coastal Salmon Recovery Fund…The conferees understand that some mechanism is necessary to assure legal and fiscal accountability for distribution of funds to States with listed salmon species."*

The reporting of recovery success depends on consistent data management standards, which in turn can support composite statistics showing cumulative actions of all federal state, tribal, and local governments.

The PNAMP data management goal is to: develop or adopt fish and habitat data collection protocols, sampling protocols and analytical methods and, to ensure that data arising from these protocols are able to be managed, shared and used.

Overview of Coordination Efforts

There are many different existing interests/initiatives concerned with improving data collection or management in the Pacific Northwest representing different constituencies, mandates and obligations. There is no common regional data management system of standards or protocols or network that links these interests and initiatives. The following includes summaries of some of the interests/initiatives.

The NPCC and NOAA Fisheries (CBCIS/Regional) Data Network Project

NOAA Fisheries and the NPCC and the regional entities supporting this effort consider it necessary to urgently develop a regional data network, taking advantage of existing databases, for improved data management and data sharing: for sub-basin planning, salmonid recovery under the Federal Columbia River Power System Biological Opinion (FCRPS BiOp), and other purposes.

The initiative results from a memorandum of agreement between the NWPCC and the NMFS. This effort is currently working on: an administrative arrangement, a cost-share agreement and a memorandum of understanding for potential partners in regional information system development. The effort is currently being expanded to cover a wider region embracing the Columbia Basin plus the regional extent of Pacific Coast salmon recovery efforts. The need has been supported within the region by the Columbia River Independent Scientific Review

Panel[5], from independent analysis by Science Applications International Corporation (SAIC)[6], and in comments received from the public.

Council contract with WDFW
The NWPCC has a contract with David H. Johnson, Washington Department of Fish and Wildlife, to develop protocols for counting salmonids, resident fish, and lampreys in the Pacific Northwest.

The project is focused on delivering a robust set of protocols for the acquisition of fish and lamprey count information. The goal of this project is to assemble, analyze and offer recommended protocols that will establish regional *compatibility* between data collection efforts and associated data sets. The data collected through the recommended protocols recommended will aid in providing a consistent foundation for plans to restore, protect, and monitor the health and biological capacity of aquatic and terrestrial habitats in the Pacific Northwest.

The Pacific Coastal Salmon Recovery Fund (PCSRF) Data Management Project
This NOAA Fisheries effort is a substantial collaborative data consolidation involving the collection of habitat restoration, acquisition and assessment project and project performance data from California, Washington, Oregon, Alaska and Tribes receiving funding under the PCSRF program.

Data Access in Real Time (DART)
DART provides access to current and historic information from sources such as StreamNet, the Fish Passage Center and others. As such, it is considered a "second tier" database. DART uses a report generator to allow users to select one or more routinely prepared documents, graphs, etc., for viewing and printing.

The Fish Passage Center (FPC)
The FPC provides analyses of alternatives for fish passage relative to flow augmentation, spill and adult passage used to formulate recommendations to the dam operators by the Basin's state and tribal co-managers. The FPC also provides reports to state water quality agencies in response to specific requests and designs and manages the Smolt Monitoring Program, the Gas Bubble Trauma Monitoring Program and the Comparative Survival Study. In addition, under the guidance of the Fish Passage Advisory Committee the FPC has developed standard smolt monitoring and data collection protocols. These standard protocols are currently in use at mainstem dams in the Columbia and Snake rivers by ODFW, USACE, BPA, WDFW, and Chelan County PUD and used at Smolt Monitoring Program tributary traps by IDFG, ODFW and the Nez Perce Tribe.

StreamNet is the Northwest Aquatic Resource Information Network
StreamNet operates a SQL Server based database containing fully referenced fish abundance, distribution and management data and an online query interface. It maintains a library and reference system for use in monitoring and evaluation of Columbia River fish stocks. StreamNet

[5] Independent Scientific Review Panel. Report of Databases Funded through the Columbia River Basin Fish and Wildlife Program. ISRP 2000-3. May 11, 2000.
[6] Science Applications International Corporation. Recommendations for a Comprehensive and Cooperative Columbia River Information Management System. Report to the NWPCC, April 30, 2003

objectively provides standardized data from the region's fish management agencies; it does not evaluate the implications of published data.

PIT-Tag Information System (PTAGIS)
This program provides database systems management and operations for the collection and distribution of PIT tag data to all interested parties. It collects data from tag detectors on hydroelectric dams on the Columbia and Snake Rivers and provides user training and support.

The Coded Wire Tag Recovery (CWT) and Regional Mark Information System (RMIS)
The CWT program provides for a joint Washington and Oregon sampling effort for coded wire tags, while the RMIS provides for the recovery and management of data from the tags that are made available through the Pacific States Marine Fisheries Commission Regional Mark Information System.

Washington State Salmon and Watershed Information Management Technical Advisory Committee (SWIMTAC)
In Washington, the Joint Natural Resources Cabinet (JNRC), the Salmon Recovery Funding Board (SRFB), and the Salmon and Watershed Information Management Technical Advisory Committee (SWIMTAC) have identified access to information as a gap and a primary focus point to improve salmon and watershed information management. SWIMTAC provides an interagency team of the leading information technology experts from the JNRC. Eleven state agencies with natural resource obligations are participating.

The FCRPS RME Data Management Plan
The RME plan includes specific recommendations for system wide-data management and for sub-basin case studies.

The Regional Technical Team for the Upper Columbia sub-basins has adopted protocols for many habitat data collection needs and a consultant study is underway to identify protocols for the John Day sub-basin.

A common system will be developed for the efficient and effective collection, management and distribution of information relating to FCRPS needs as specified in BiOp for actions 179-199. The system will be verified for compatibility with the fish and wildlife data-management requirements for the Columbia River Basin. The BiOp RME database will be incorporated into a regional data-management system when such a system is developed.

Specific recommendations are:

1. Develop an overall RME information system architecture—a detailed blueprint or design of the RME system.
2. Take advantage of existing, potential data centers. Include information portals/distributed database-management system tools as necessary to consolidate data and communicate using the Internet.
3. Develop a data management cost-sharing approach to achieve BiOp requirements.
4. Promote the free exchange of information and development of a systems view of the Columbia River Basin.

Accomplishments to Date

Data management coordination is a relatively new aspect of PNAMP and a workgroup has recently been formed. There are not yet any accomplishments of the workgroup per se. There are however, related accomplishments in existing programs that provide examples of solutions to some of the PNAMP data coordination needs, examples of which are briefly described below.

The PCSRF governmental entities have agreed to a set of common reporting metrics for the purpose of reporting habitat restoration and acquisition project implementation monitoring performance. A stage II effort will collect PCSRF effectiveness monitoring data from the participating entities.

The REO, with assistance from state and federal agencies agreed on a system for development of geospatial hydrography layers for Washington and Oregon HUC 6 watersheds, which allowing sharing of geospatially referenced hydrological data among federal, state, tribal, and local agencies.

The SWIMTAC has developed "Guidelines" on behalf of the participating Washington state agencies and represents the preferred practices of the participating agencies in regard to data management, data sharing, and data coordination. To the extent possible and necessary, the participating agencies will condition their internal policies, contracts, and databases that affect salmon and watershed data to comply with these "Guidelines." SWIMTAC has also created a data portal (www.swim.wa.gov) where all Washington state databases associated with salmon recovery and watershed health can be accessed.

Oregon Watershed Enhancement Board (OWEB)

OWEB has been exploring funding a data portal that would access all Oregon state databases involved with salmon recovery and watershed health.

Where Do We Need To Go?

Data management coordination for PNAMP should follow a consistent data management methodology[7] that breaks the tasks into distinct steps:

1. Assessing needs and gathering requirements. Understanding the necessary data products, the people who are involved, and when products are needed.
2. Developing a detailed PNAMP Data Management Coordination Project Plan. Set out the time frame for deliverables, who will do what and when and cost/cost share.
3. Analyzing the requirements. The requirements need to be described in data management terms.
4. Designing, developing and testing solutions.
5. Transition and training.
6. Deployment.
7. Maintenance.
8. Independent validation and verification.

[7] For example. Barker, R and Clegg, D. 1994. Case Fast Track A RAD Approach. Oracle Press. Addison Wesley.

The PNAMP data management coordination effort is currently at the first step involving the assessment of needs and requirements. The 'clients' for the effort are the three PNAMP workgroups: Watershed Condition Monitoring, Fish Population Monitoring, and Effectiveness Monitoring. The workgroups will identify their specific data management needs.

In addition the PNAMP group as a whole is likely to have needs that go beyond individual work group needs. The collective needs will also have to be identified.

When the data management coordination needs of the PNAMP are identified and documented they will need to be compared to other ongoing data management efforts. For example, the CBCIS/regional program has identified steps for actions relating to regional data management standards and protocols and improved data availability and sharing (including aquatic monitoring) as follows:

CBCIS/Regional Data Management Steps[8]
PHASE I (9 months)
Establish a high-level agreement (MOU or stronger document) endorsing a regional data network and pledging signatory support.
Develop the regional data network as a base-funding category, not to be re-competed for on an annual basis.
Expand outreach efforts to seek buy-in from other key decision-makers and stakeholders in the region. Develop targeted outreach and education materials for key regional data network participants and supporters that clearly outline the need for a regional data network and describe the benefits and costs for such an endeavor. Ensure this outreach approach addresses the need for long-term support for a regional data network to succeed.
Formalize an accountable regional data network administrative framework.
Identify a regional data network Coordinator and Project Manager.
Develop communication and coordination hub of regional data network.
PHASE II (18-24 months) Developing adopting and deploying regional standards and protocols
Research and post inventory (ies) of existing standards and protocols in the region.
Develop and post regional data network standards for reporting geographic data: locations and projections
Incorporate regional data network requirements into future grants and contracts.
Develop regional data network monitoring protocols and data standards addressing data collection, storage and analysis.
Develop and post regional Quality Assurance and Quality Control procedures and protocols.
Develop and implement region-specific metadata tools.
Complete the preliminary inventory of information resources in the region.
Develop and post a regional data network guidance manual that documents everything needed to become a regional data network participant.
Develop regional data network technical assistance.

[8] Approved by the NPCC, December 2003.

PHASE III (Duration tbd) Planning, supporting and maintaining regional network capability
Write a long-term regional information system development plan.
Develop a process for evaluating proposed project relevance to goals as part of the grant and contract process.
Develop a long-term resource plan (staff and dollars) for the regional data network.
Develop a strong operations and maintenance plan.
Develop a regional data network using a distributed system architecture based on an enterprise approach.
Develop tools that will enable searching, accessing, acquiring, sharing, and contributing information resources about the regional resource management efforts.
Establish guidelines for becoming a regional data network node.

It is likely that PNAMP will identify data management coordination roles that relate directly to needed **Aquatic Monitoring** components of the CBCIS/Regional data management effort, for example:

1. Common protocols for aquatic monitoring sampling design, data collection, and data analysis
2. An inventory of significant aquatic monitoring databases identifying all baseline data, assets, and resources
3. Resolution of different spatial data format requirements for aquatic monitoring across the state, local, tribal, and federal levels
4. Aquatic monitoring metadata standard and requirements
5. A regional data dictionary for aquatic monitoring
6. Data portal/s development to provide, access to data, downloads of datasets, maps and charts, ad-hoc queries from selected datasets; and, access to non-state, federal and local aquatic monitoring data resources
7. Data portal interfaces to allow information from multiple aquatic monitoring databases to be consolidated into single (consistent) reports
8. Strategic data management programming to ensure strategic investments in aquatic monitoring information systems, and;
9. Sub-basin data management prototype for aquatic monitoring and evaluation

Timeline

Dates	Activities	Comments
February 2004	Complete detailed assessment of the data management coordination needs of PNAMP work groups and the PNAMP group as a whole	Begin with review of available needs assessments, for example: CBCIS, SWIMTAC, other
May 2004	Complete the PNAMP needs assessment including a gap analysis to determine what data management needs can be met by existing programs and what needs can be met with PNAMP coordination	Work closely with other state, tribal and federal data standard efforts – for example the SWIMTAC effort.
June 2004	Develop a PNAMP Data Management Coordination Plan including deliverables, timetable and budget.	
July 2004 and ongoing	Support PNAMP Data Management Coordination Plan Deliverables	

Resources Needed

The cost of the needs/requirements assessment will depend on the scope and extent of needed data management time and skills.

Dates	Activities	Cost
Feb 2004	Funding for PNAMP data coordination needs assessment	$30-55K
Feb 2004	Support PNAMP data management coordination subcommittee meeting process.	$30K
Feb 2004	In kind agency contributions	tbd

Appendix A

List of Participants in the Pacific Northwest Aquatic Monitoring Partnership.

Primary agency and tribal participants involved in shaping the current planning document:
Aquatic-Riparian Effectiveness Monitoring Program: Steve Lanigan
Bonneville Power Administration: Jim Geiselman
Bureau of Reclamation: Michael Newsom
California North Coast Watershed Assessment Program: Scott Downie
Columbia Basin Fish and Wildlife Authority: Frank Young
Columbia River Inter-Tribal Fish Commission: Phil Roger
Colville Tribes: Keith Wolf
Idaho Fish and Game: Sam Sharr
NOAA Fisheries Northwest Fisheries Science Center: Steve Katz
Northwest Power and Conservation Council: Steve Waste
Oregon Department of Environmental Quality: Rick Hafele
Oregon Watershed Enhancement Board: Kelly Moore
Pacific States Marine Fisheries Commission: Bruce Schmidt
US Environmental Protection Agency: Dave Powers, Phil Larsen, Steve Ralph
US Forest Service – Region 6: Deb Konnoff
US Forest Service – Region 6: Deb Whitall (facilitator)
US Geological Survey: Dave Busch
Washington Department of Fish and Wildlife: David Johnson
Washington Department of Ecology: Steve Butkus
Washington Governor's Salmon Recovery Office: Steve Leider
Washington Salmon Recovery Funding Board and Interagency Committee for Outdoor Recreation: Bruce Crawford

Other agencies/organizations that have participated in Partnership efforts:
Army Corps of Engineers
Bureau of Land Management
California Department of Fish and Game
Confederated Tribes of Umatilla Indian Reservation
Oregon Department of Fish and Wildlife
Oregon State University
US Fish and Wildlife Service
US Forest Service – Fish and Aquatic Ecology Unit
US Forest Service – Region 5
US Forest Service Pacific Northwest Research Station
US Forest Service Washington Office
US Forest Service Stream Systems Technology Center
US National Park Service

Appendix B

These proposed costs are initial estimates of what is likely to be needed, but should be expected to change as participation increases/decreases. No entities or agencies have yet committed to the direct expenditures or inkind contributions.

Summary of Budget Information

			Workgroups				Total	
	Coord among groups	Steering Committee	Watershed Condition	Fish Population	Effectiveness	Data Management	FTE	Cost
# meetings & wksps		6	5	5	5	5		
Coordinator	0.4	0.4	0.05	0.05	0.05	0.05	1	$100,000
Indirect costs								$50,000
Meeting facilitator		$4,800						$4,800
Needs assessment						$55,000		$55,000
								$209,800
Policy and Technical Participation		inkind	$15,000.00	$15,000.00	$15,000.00	$15,000.00		$60,000
								$269,800
Inkind support								
AREMP - Watershed team leader		$3,600	$4,500		$3,000	$3,000		$14,100
OWEB - Effectivness team co-leader		$3,600	$3,000		$4,500	$3,000		$14,100
SRFB - Effectivness team co-leader		$3,600	$3,000	$3,000	$4,500	$3,000		$17,100
Colville Tribes - Fish pop team co-leader		$3,600	$3,000	$4,500		$3,000		$14,100
IF&G - Fish pop team co-leader		$3,600	$3,000	$4,500		$3,000		$14,100
NOAA - data managmemt team leader		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
BLM		$3,600	$3,000			$3,000		$9,600
BPA		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
CA F&G		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
CBFWA		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
Chelan Co. PUD				$3,000		$3,000		$6,000
COR		$3,600	$3,000			$3,000		$9,600
CRITFC		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
CTUR		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
EPA			$3,000		$3,000	$3,000		$9,000
FPC				$3,000		$3,000		$6,000
King Co.				$3,000	$3,000	$3,000		$9,000
MDFWP				$3,000		$3,000		$6,000
NOAA Science Center		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
NPS			$3,000		$3,000	$3,000		$9,000
NWIFC		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
NWPCC		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
ODFW			$3,000	$3,000		$3,000		$9,000
USBOR		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
USFS PNW		$3,600	$3,000		$3,000	$3,000		$12,600
USFWS		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
USGS		$3,600	$3,000		$3,000	$3,000		$12,600
WA GSRO		$3,600	$3,000	$3,000	$3,000	$3,000		$15,600
YN				$3,000		$3,000		$6,000
								$365,100